

Claims

1. Method for treatment of a fluid quantity including chemical reacting means such as combustible materials above a certain minimum quantity in a catalytic device (1), said method comprises the steps of:

entering said fluid quantity into the catalytic device (1) through an inlet (2),

directing said fluid quantity through at least three mutually connected passage sections (3, 5, 11, 22) of said catalytic device in which said at least three passage sections include a main reaction passage section (3) heat exchanging in counterflow with a main heat transfer passage section (5), wherein at least one section includes catalytic material of one or more kinds in which the catalytic material reacts with and/or enhances the reactions of said combustible materials; and wherein at least one of said at least three passage sections, such as said main heat transfer passage section, comprises a plurality of substantially parallel pipes,

heating or cooling said fluid quantity in said at least three passage sections by said internal heat exchange in said catalytic device between said sections, and

emitting the treated fluid quantity from the catalytic device through an outlet (8).

2. Method according to claim 1 wherein a main reaction passage section (3) heat exchanges with a main heat transfer passage section (5), and where the main reaction passage section heat exchanges with one or more preceding inlet passage sections (11) and/or one or more succeeding outlet passage sections (22).

3. Method according to claim 1 or 2 wherein the fluid quantity is directed through the succeeding passage sections (3, 5, 11, 22) in counterflow.
4. Method according to any of claims 1 to 3 wherein further combustible material is added directly or indirectly to the catalytic device (1).
5. Catalytic device (1) for treatment of a fluid quantity including chemical reacting means such as combustible materials above a certain minimum quantity, said device comprising
- a container (c) including at least one inlet and outlet for said fluid quantity,
- said container further comprises at least three passage sections (3, 5, 11, 22) being mutually connected, where at least one section (3) of said passage sections (3, 5, 11, 22) includes catalytic material (4) of one or more kinds,
- c h a r a c t e r i s e d i n t h a t
- the positioning of said passage sections (3, 5, 11, 22) forms at least one internal heat exchanger (h) with mutual heat exchange between the sections (3, 5, 11, 22),
- where the main reaction passage section (3) heat exchanges in counterflow with the main heat transfer passage section (5) of said at least three passage sections (3, 5, 11, 22), and
- where at least one of said at least three passage sections, such as said main heat transfer passage section (5), comprises a plurality of substantially parallel pipes.

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6. Catalytic device (1) according to claim 5, characterised in that said catalytic device comprises three passage sections (3, 5, 11, 22).
7. Catalytic device (1) according to claim 5 or 6, characterised in that said one or more inlet passage sections (11) is positioned above, alongside or outside said main reaction passage section (3) e.g. by surrounding said section.
8. Catalytic device (1) according to any of claims 5 to 7, characterised in that said one or more outlet passage sections (22) is positioned above, alongside or outside said main reaction passage section (3) e.g. by surrounding said section.
9. Catalytic device (1) according to any of claims 5 to 8, characterised in that said main reaction passage section (3) is positioned above, alongside or outside said main heat transfer passage section (5) e.g. by surrounding said section.
10. Catalytic device (1) according to any of claims 5 to 9, characterised in that at least one of said at least three passage sections, such as said main heat transfer passage section (5), comprises one or more substantially parallel pipes.
11. Catalytic device (1) according to claim 10, characterised in that said main heat transfer passage section (5) is integrated as a number of pipes in said main reaction passage section (3).
12. Catalytic device (1) according to claim 10 or 11, characterised in that said number of pipes is between 20 and 1000 pipes and preferably between 50 and 250 pipes.

13. Catalytic device (1) according to any of claims 10 to 12, characterised in that said pipes form symmetrical patterns such as triangular, quadrangular or similar patterns or random patterns.
- 5 14. Catalytic device (1) according to any of claims 10 to 13, characterised in that said pipes is surrounded by catalytic material (4) deposited on one or more carrier means (17-21).
- 10 15. Catalytic device (1) according to any of claims 5 or 14, characterised in that said pipes comprise a circular, an oval, a triangular, a four-sided or any similar regular or irregular cross sectional shape.
- 15 16. Catalytic device (1) according to any of claims 5 to 15, characterised in that at least one of said three passage sections, such as said main heat transfer passage section (5), comprises one or more lamellar plates.
- 20 17. Catalytic device (1) according to claim 16, characterised in that said one or more lamellar plates form non-circular canals e.g. with a cross sectional shape formed by triangles, four sided shapes, combinations hereof or similar shapes.
- 25 18. Catalytic device (1) according to claim 16 or 17, characterised in that indentations in the surface of said one or more lamellar plates form longitudinal or diagonal patterns.
- 30 19. Catalytic device (1) according to any of claims 5 to 18, characterised in that said catalytic material (4) is

deposited on one or more carrier means (17-21) in at least one of said at least three passage sections (3, 5, 11, 22).

20. Catalytic device (1) according to any of claims 14 to 19,
5 characterised in that said one or more carrier means (17-21) are made in metal, ceramic, glass or other heat resistant materials as well as combinations of the mentioned materials.

21. Catalytic device (1) according to any of claims 14 to 20,
10 characterised in that said one or more carrier means (18) include at least one shape such as spherical, cylindrical or quadrangular shapes as well as saddle, ring, regular or irregular shapes.

22. Catalytic device (1) according to any of claim 14 to 21,
15 characterised in that said one or more carrier means (17-21) include a number of regular or irregular balls (18) in layers (L) across one of said passage sections, each layer being positioned perpendicularly between two adjacent pipes, and each of said layers comprising 2 to 6 balls, such as 2 to 4 and preferably between 2 and 3.

20 23. Catalytic device (1) according to any of claims 14 to 22, characterised in that said one or more carrier means (17-21) include monoliths (19, 21) or fibres (17, 20).

25 24. Catalytic device (1) according to claim 23, characterised in that said fibres (17, 20), deposit with said catalytic material form a tangled bundle of fibres partly or totally filling one or more of said passage sections.

30 25. Catalytic device (1) according to claim 23 or 24, characterised in that said monoliths (19, 21) or fibres (17, 20), deposit with said

catalytic material (4) form longitudinal monoliths or fibres inside one or more of said passage sections.

- 5 26. Catalytic device (1) according to any of claims 5 to 25, characterised in that said main reaction passage section (3) of said at least three passage sections (3, 5, 11, 22) comprises one or more kinds of said catalytic material (4) deposit on said carrier means (17-21).
- 10 27. Catalytic device (1) according to any of claims 5 to 26, characterised in that said one or more inlet and/or outlet passage sections (11, 22) of said at least three passage sections (3, 5, 11, 22) comprises one or more kinds of said catalytic material (4) deposit on said carrier means (17-21).
- 15 28. Catalytic device (1) according to any of claims 5 to 27, characterised in that one or more of said at least three passage sections comprise combined carrier means including wall flow filters (21), fibres (17, 20), balls (18) and/or monoliths (19) e.g. 1/3 passage section as wall flow filters and the rest of the section as fibres, balls or monoliths.
- 20 29. Catalytic device (1) according to claim 28, characterised in that said combined carrier means are positioned in continuation of each other through one or more of said at least three passages.
- 25 30. Catalytic device (1) according to any of claims 5 to 29, characterised in that said catalytic material (4) includes metal or metal alloys from the Platinum metal group such as Platinum (Pt), Palladium (Pd), Rhodium (Rh) or combinations hereof.
- 30 31. Catalytic device (1) according to any of claims 5 to 30, characterised in that said catalytic material (4) includes

metal oxides such as Gold (Au), Platinum (Pt), Silver (Ag), Aluminium (Al), Lead (Pb), Zirconium (Zr), Copper (Cu), Cobalt (Co), Nickel (Ni), Iron (Fe), Cerium (Ce), Chrome (Cr), Tin (Sn), Manganese (Mn) and Rhodium (Rh) Oxides or combinations hereof.

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32. Catalytic device (1) according to claim 30 or 31, characterised in that said catalytic material (4) includes combinations of metal or metal alloys from the Platinum metal group and metal oxides.
- 10 33. Catalytic device (1) according to any of claims 5 to 32, characterised in that said main reaction passage section (3) heat exchanges with said main heat transfer passage section (5) of said at least three passage sections (3, 5, 11, 22).
- 15 34. Catalytic device (1) according to claim 33, characterised in that said main reaction passage section (3) heat exchanges with said main heat transfer passage section (5) in counterflow.
- 20 35. Catalytic device (1) according to any of claims 5 to 34, characterised in that said main reaction passage section (3) heat exchanges with said one or more previous inlet and/or succeeding outlet passage sections (11, 22).
- 25 36. Catalytic device (1) according to claim 35, characterised in that said main reaction passage section (3) heat exchanges with said one or more inlet passage sections (11) in counterflow.
- 30 37. Catalytic device (1) according to claim 35, characterised in that said main reaction passage section (3) heat exchanges with said one or more outlet passage sections in concurrent flow.

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38. Catalytic device (1) according to any of claims 5 to 37 characterised in that said device comprises at least one layer of insulation (12) between said at least three passage sections (3, 5, 11, 22).

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39. Catalytic device (1) according to claim 38, characterised in that said at least one layer of insulation (12) is positioned between said main reaction passage section (3) and said one or more inlet passage sections (11).

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40. Catalytic device (1) according to any of claims 5 to 39, characterised in that the cross-sectional area of said main reaction passage section (3) is between 0.5 and 100 times, such as between 10 and 25 times, preferably about 20 times, the cross-sectional area of said main heat transfer passage section (5) and/or said inlet or outlet passage sections (11, 22) are between 0.5 and 100 times, the cross-sectional area of said main heat transfer passage section (5).

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41. Catalytic device (1) according to any of claims 5 to 40 characterised in that the cross-sectional area of the main heat transfer passage section (5) is between 0.5 and 10 times, such as 1.5 to 2.5 times, preferably about 2 times, the cross-sectional area of the inlet (2) of the catalytic device, said inlet pipe (2) being the exhaust pipe for the connected internal combustion engine.

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42. Catalytic device (1) according to any of claims 5 to 41, characterised in that at least one of said passage sections (3, 5, 11, 22) comprises one or more wall flow filters (21) with numerous porous walls (16) allowing fluid quantity (15) to penetrate through the walls.

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43. Catalytic device (1) according to any of claims 5 to 42 characterised in that further combustion material is added to the device, e.g. through a fuel line (S4) connected to the fuel tank and the fuel supplying means (S1), or through adding further combustion material to the fluid quantity.
44. Use of a method for treatment of a fluid quantity comprising chemical reacting means such as combustible materials above a certain minimum quantity in a catalytic device according to any of claims 1 to 4 for cleaning exhaust gas from internal combustion engines.
45. Use of a method for treatment of a fluid quantity comprising chemical reacting means such as combustible materials above a certain minimum quantity in a catalytic device according to any of claims 1 to 4 for temperature regulation or control in connection with any exothermal or endothermal chemical reaction in an industrial chemical application.
46. Use of a method for treatment of a fluid quantity comprising chemical reacting means such as combustible materials above a certain minimum quantity in a catalytic device according to any of claims 1 to 4 for temperature regulation or control in or in connection with fuel cells.
47. Use of a catalytic device according to any of claims 5 to 43 in connection with combustion engines in vehicles such as engines fuelled by petrol, diesel, natural gas, bottled gas or any similar fuels.
48. Use of a catalytic device according to any of claims 5 to 43 in connection with stationary combustion engines such as engines fuelled by petrol, diesel, natural gas, bottled gas or any similar fuels such as in power plants e.g. combined heat and power plants.

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49. Use of a catalytic device according to any of claims 5 to 43 in connection with any exothermal or endothermal chemical reaction in an industrial chemical application.
- 5 50. Use of a catalytic device according to any of claims 5 to 43 in temperature regulation or control in or in connection with fuel cells.